Laboratory Imaging Spectroscopy (0.4-5.1 μm) of Rocks and Minerals with the Cassini VIMS Instrument

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The Cassini Visual and Infrared Mapping Spectrometer (VIMS) instrument is an imaging spectrometer covering the 0.4 to 5.1 μm wavelength region with 352 spectral channels, and with a spacing of approximately 16 nm, and a Full Width at Half Maximum (FWHM) of approximately 13 nm. The VIMS is also a spatial imager with a field of view of 64 by 64 pixels. During the VIMS thermal vacuum testing, a target projector transferred a 10 cm square image into the thermal vacuum chamber where the VIMS was maintained in a space environment similar to what it will encounter at Saturn. The VIMS 64x64 pixel field gave a spatial resolution in the projector focal plane of about 1.5 mm. Several rock and mineral test targets, chosen to have absorption bands in various VIMS wavelength regions, were measured. The resulting imaging spectroscopy data sets were compared in several ways, including pseudo-true color imaging, false color imaging, and spectral mapping with the USGS Tricorder algorithm. The Tricorder algorithms compare spectral features from a spectral library and search for those features in the VIMS data. Color-coded maps of the minerals found are compared to actual knowledge of the minerals present in the rocks. The results illustrate the power of imaging spectroscopy over traditional imaging or false color imaging. Many minerals can't be distinguished in true color, while false color (including IR wavelengths chosen in or near diagnostic absorption bands) discriminates some minerals, but not even all of the same type. For example, a mineral sample depicted red in a false color image may appear as a completely different color for another sample of the same mineral, but with a different grain size. Sample purity also affects false color discrimination. However, spectral analysis properly identifies the mineralogy, thus supporting the prediction that VIMS will be a very effective instrument at Saturn.

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